

Self-efficacy for eating a healthy diet can moderate the impact of stress on diet quality

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ABSTRACT

Introduction. Family child care home (FCCH) providers are individuals who care for children in their own home. This group has been identified as at-risk for high stress and poor sleep quality, contributing to poor health behaviors. High self-efficacy for the diet may moderate the relationship between these risk factors and diet quality. Little research has examined how these factors may relate to one another when describing the health of FCCH providers.

Methods. We utilized baseline data on FCCH providers from the cluster-randomized control trial Keys to a Healthy Family Child Care Home. We estimated correlations between self-reported perceived stress, sleep quality, diet self-efficacy and diet quality. A linear regression including interaction terms was run to assess how diet self-efficacy may moderate the relationships between perceived stress and sleep quality, respectively, and diet quality.

Results. Perceived stress and sleep quality were not significantly correlated with diet quality in this population. However, diet self-efficacy was identified as a moderator of the association between perceived stress and diet quality. With high diet self-efficacy, increasing perceived stress was associated with improved diet quality.

Conclusion. Improving self-efficacy may be one critical strategy for improving the health of a population at-risk for poor behaviors. As FCCH providers care for many children and model behaviors, improving their diet quality may positively impact the children in their care.

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INTRODUCTION

Obesity is a growing public health concern, and there is evidence to suggest that it disproportionately affects women. In the United States, obesity increased consistently for women from 2005 to 2014, culminating in a 40% prevalence for women, compared to only 35% in men.¹

A group of women particularly susceptible to poor diet quality, potentially increasing obesity risk, are early childhood educators (ECEs). Over 95% of those working as ECEs in the United States are women, and their pay is low; in 2016, their average weekly income was \$621 compared to the overall national average for women of \$749.² Income inequality within a population is associated with a greater prevalence of obesity among women, independent of average calorie intake.³ Indeed, multiple studies of women who work in early education show a high prevalence of overweight and obesity.⁴⁻⁶ One study of a nutrition intervention trial in child care centers in North Carolina found that up to two-thirds of ECEs were classified as obese.⁶

High job-related or overall stress has been associated with poor diet quality, lack of physical activity, and weight gain in women.⁷⁻⁹ ECEs often report above average depressive symptoms and diagnosed depression.^{5-6,11} Citing their many stressors, ECEs describe frequent sleep disturbances¹¹ and get less than the recommended amount of sleep.⁶ In turn, low quality sleep contributes to weight gain and decreased appetite control.¹¹⁻¹²

A child's time spent in child care has been shown to correlate with an increased BMI by age three,¹³ and the feeding practices of ECEs is associated with the overall quality of a child's diet.¹⁴ Since over 60% of children in the United States are enrolled in some out-of-home child care arrangement before the age of five,¹⁵ these findings imply that ECEs have a unique and vast

opportunity to influence the trajectory of the health of children under their care. Given the influence of child care, as well as the obvious implications of obesity on individual health, it is important to address determinants of obesity in this at-risk population.

Bandura's Social Cognitive Theory (SCT) posits that social-cognitive factors, such as self-efficacy, are central to the adoption of beneficial health behaviors such as improved diet.¹⁶ Self-efficacy captures an individual's perceived capability to accomplish a specific action.¹⁷ Indeed, improvements in self-efficacy have been shown to positively affect consumption of fat, fiber, and fruits and vegetables.¹⁸ In another study, participants' weight changed concomitantly with self-efficacy over 18 months; participants lost weight overall as their self-efficacy increased, and subsequently regained weight as self-efficacy decreased.¹⁹

SCT argues further that, in individuals with high self-efficacy, stressors are more likely to induce coping behaviors than anxiety.¹⁷ According to a survey administered to ECEs in Texas, as many as 71% are attempting to improve their diet and lose weight.⁴ Unfortunately, reported self-efficacy is low. They lack the knowledge and confidence to discern nutrition information, which results in dietary behaviors that are not conducive to their weight-loss goals.⁴ Amongst ECEs, there is great need for improved diet as well as a readiness to change, but the problem of obesity perpetuates. Improving their knowledge and self-efficacy could be key to improving the health of this population in the face of high stress and poor sleep.

Intervention may be particularly important for family child-care home (FCCH) providers, who care for children in their own home. Their average income is lower than their center-based counterparts, which could put them at further risk for poor diet quality and obesity.²⁰ Despite this, there is little available research dedicated to describing the health of FCCH providers

specifically and what contributes to their diet quality. This paper seeks to fill the gap in the research for this important sub-population of ECEs.

The purpose of this study is to elucidate the impact of sleep, stress, and self-efficacy on diet quality in FCCH providers using baseline data from the Keys to a Healthy Family Child Care Home intervention implemented in FCCHs in North Carolina. It is hypothesized that high stress and poor sleep will be correlated with poor diet quality in the FCCH providers. Self-efficacy may be central to the ability of an FCCH provider to overcome these barriers. Thus, the moderating effect of self-efficacy on the relationship between stress and sleep and diet quality, respectively, will be assessed. It is hypothesized that self-efficacy will act as a moderator and that high self-efficacy in an FCCH provider will contribute to high diet quality, even in instances of high stress and poor sleep.

METHODS

This cross-sectional study used baseline data from the two-arm, cluster-randomized control trial Keys to Healthy Family Child Care Homes (Keys). Keys examined the effect of a three-part childhood obesity prevention intervention delivered to FCCH providers over 9 months. It was designed to improve child diet quality and physical activity and was implemented by researchers from the University of North Carolina at Chapel Hill and Duke University. All study protocols were approved by both Institutional Review Boards. Specific details on study protocol and recruitment are published elsewhere.²¹⁻²² Relevant study details are described below.

Recruitment

To recruit potential participants, licensed FCCHs were identified through a publicly available database on the NC Division of Child Development website.²³ Then, community partners who work with FCCHs were contacted to introduce Keys to FCCH providers. FCCHs were then sent an informational flyer via mail and email with an invitation to participate in Keys. Subsequently, project staff contacted FCCH providers by phone to discuss project details, gauge interest, and determine eligibility. In order to be eligible for inclusion, FCCHs were required to have at least two children between the ages of 1.5 and 4 years enrolled, serve at least one meal and one snack, be open year-round, and have been in business for two years with no plans to close in the following year. Eligible FCCH providers were delivered welcome packet materials, including consents for enrolled children 1.5- to 4-years old. Consent from at least two children were required in order for FCCHs to participate in the study. Once consented, two day-long

home visits (Monday/Wednesday or Tuesday/Thursday) were scheduled. During these on-site visits, FCCH providers filled out surveys for the baseline data relevant to this study.

Measures

1. Demographics

FCCH providers' demographic information was collected using a survey. The providers reported personal characteristics such as age, race, sex, and income.

2. Diet quality

Provider diet quality was assessed using the 2000 Brief Block Food Frequency Questionnaire (FFQ). Multiple studies found high correlations between a reduced and full version of the original FFQ, justifying the use of a shortened version.²⁴ The Brief Block FFQ is a dietary recall using 72 commonly consumed foods from the National Health and Nutrition Examination Survey III,²⁵ designed to assess usual dietary intake. Providers recalled how often and what portions of these foods were consumed over the past 3 months. Surveys were sent to NutritionQuest for data entry, and servings per day adjusted for typical daily kilocalorie intake were calculated.

Using data from NutritionQuest, a modified 2010 Healthy Eating Index (HEI) score was calculated using similar scoring to the daily 2010 HEI.²⁶⁻²⁷ The modified HEI consisted of 12 dietary components – including both adequacy components (whole fruit, total fruit, total vegetables, greens and beans, whole grains, dairy, seafood and plant protein, total protein, and fatty acids) and moderation components (refined grains, sodium, and empty calories). Component scores were estimated by comparing the adjusted servings per day from the FFQ to the 2015 Dietary Guidelines for Americans. For each food, servings per day were used to

calculate cup equivalents, and minimum and maximum scores were set to compute each component score. Finally, component scores were summed to produce a final modified total HEI score from 0 to 100, where higher scores indicated better diet quality.

3. Sleep quality

Sleep quality was assessed using the nine-item Sleep Problems Index from the Medical Outcomes Study sleep scale.²⁸ Providers rated how often in the past week they experienced specific sleep problems on a 1 (none of the time) to 6 (all of the time) scale. Then, the responses were recoded to a 0 to 100 value, with relevant items reverse coded. The Sleep Problems Index was calculated as an average of the nine items, ranging in possible scores from 0 to 100, with higher scores corresponding to more sleep issues.²⁹ The Sleep Problems Index has repeatedly been shown to have good internal consistency and satisfactory construct validity in previous studies of adults with neuropathic pain,³⁰ diabetic peripheral neuropathy,³¹ fibromyalgia,³² and restless leg syndrome.³³ Internal consistency was high among Keys participants as well (Cronbach's alpha = 0.82).

4. Perceived stress

Provider stress was assessed using the 10-item version of the Perceived Stress Scale (PSS).³⁴ The PSS has demonstrated acceptable internal consistency, as well as construct validity.³⁴⁻³⁵ The PSS consisted of statements about the frequency of stressful thoughts and feelings over the past month. Providers responded on a 1 to 5 scale, where 1 was "never" and 5 was "very often." Positive items in the survey were reverse-coded, and then all items were

summed. Scores ranged from 10 to 50, such that higher scores represented higher perceived stress. PSS internal consistency was good among Keys participants (Cronbach's alpha = 0.84).

5. *Diet self-efficacy*

In order to evaluate provider self-efficacy, providers responded to a 24-item questionnaire containing statements relating to their perceived confidence to overcome specific challenges to healthy eating and make healthy food choices. Each item was scored on a 1 to 5 scale, where 1 was "not at all confident" and 5 was "extremely confident." Five self-efficacy subscales were created – nutrition action, nutrition coping, fat reduction, fruit and vegetable consumption, and dietary fiber – by averaging responses to relevant survey items.

Items used to develop subscales for nutrition action and coping self-efficacy were first used in the Berlin Risk Appraisal and Health Motivation Study (BRAHMS), which examined social-cognitive determinants of preventive nutrition.³⁶ Nutrition action refers to a participant's perceived ability to develop a plan of action and adopt new dietary behaviors, while nutrition coping is a measure of a participant's perceived capability to anticipate and dissolve barriers that arise during behavior change. BRAHMS found that the self-efficacy scales for nutrition action and coping had good internal consistency. Cronbach's alpha for the present study was 0.90 and 0.93 for nutrition action and coping, respectively. Subscales for self-efficacy in fat reduction, fruit and vegetable consumption, and dietary fiber were calculated using items from a study on psychosocial measures and dietary behaviors.³⁷ This study found that these three subscales demonstrated both internal consistency and test-retest reliability. In the present study, Cronbach's alpha for the fat reduction, fruit and vegetable consumption, and dietary fiber subscales was 0.94, 0.89, and 0.93 respectively.

As correlations among all five subscales were high ($r = 0.56-0.88$), a diet self-efficacy score was created to capture participant's self-efficacy for various aspects of healthy eating in one global measure. To create the diet self-efficacy score, the subscales described above were summed. This new score ranged from 5 to 25. Higher scores indicated an individual felt more confident in her overall nutrition knowledge and capabilities. Internal consistency for this global diet self-efficacy score was excellent (Cronbach's $\alpha = 0.91$).

6. Body mass index (BMI)

Provider height and weight were measured during the day-long home visits. According to standard protocol, at least two measurements were taken for both height and weight, averaged, and used to calculate BMI in kg/m^2 .

Data analyses

Descriptive statistics were reported for both FCCH provider demographics and key study measures. A Pearson correlation matrix was used to examine the associations between all three predictors (sleep quality, perceived stress, and diet self-efficacy) and the outcome (total HEI).

The potential moderating effect of diet self-efficacy on diet quality was explored with an additional linear regression to predict HEI score. This model was run in two blocks. Provider BMI and income were selected as covariates a priori due to their potential effects on diet quality and associations with sleep quality and perceived stress. The first block included terms for sleep quality, perceived stress, and diet self-efficacy. The second block added interaction terms for both perceived stress and sleep quality with diet self-efficacy. Variables were centered prior to creation of interactions terms and inclusion in this model. For significant interactions, the

direction of the moderating effect was determined by creating a two-way interaction plot in Microsoft Excel 2016.

Individuals with missing data for any relevant measure were excluded from the models. The regression model was tested for linearity, multivariate normality, homoscedasticity, and absence of multicollinearity. Significance was set at $p < 0.05$. Analyses were completed using IBM SPSS Statistics (version 25.0).

RESULTS

Baseline characteristics of the FCCH providers in Keys are reported in Table 1. The sample consisted of entirely female providers with a mean age of 49.4 years. The providers were majority Black/African-American (74.1%), non-Hispanic (95.2%), and obese (65.7%). Yearly household income was more variable, with just over half the providers reporting an income between \$25,000 and \$50,000. Finally, almost three-quarters of the Keys providers had received an associate degree or greater.

Table 1. Baseline characteristics of FCCH providers in Keys

Characteristic	N (%)
<i>Female</i>	166 (100)
<i>Age (years)</i>	49.4 ± 9.1 ^a
<i>Race</i>	
White/Caucasian	30 (18.1)
Black/African-American	123 (74.1)
Other	13 (7.8)
<i>Hispanic or Latino</i>	8 (4.8)
<i>Yearly household income</i>	
Under \$25,000	38 (22.9)
\$25,000-\$50,000	87 (52.4)
More than \$50,000	36 (21.7)
Missing	5 (3)
<i>Education level</i>	
High school diploma or GED	40 (24.1)
Associate degree or equivalent	81 (48.8)
Bachelor's degree or greater	42 (25.3)
Missing	3 (1.8)
<i>BMI (kg/m²)</i>	33.2 ± 7.5 ^a
<i>BMI category</i>	
Normal weight	17 (10.2)
Overweight	40 (24.1)
Obese	109 (65.7)

^aReported as mean ± SD

Table 2 presents the descriptive statistics for measures of diet quality, sleep quality, perceived stress, and diet self-efficacy. Correlations were estimated between total HEI and provider sleep quality, perceived stress, and diet self-efficacy. These correlations are presented in Table 3. All correlations were in the expected direction; however, only diet self-efficacy was significantly related to total HEI score ($r = 0.33$, $p < 0.01$). A significant correlation was also found between perceived stress and sleep quality, ($r = 0.39$, $p < 0.01$) such that higher perceived stress was associated with more sleep problems. Additionally, higher perceived stress was associated with lower diet self-efficacy ($r = 0.32$, $p < 0.01$).

Table 2. Descriptive statistics for diet quality, sleep quality, perceived stress, and diet self-efficacy

Measure	N	Mean (SD)	Range	Score Range
<i>Total HEI</i>	164	59.6 (9.4)	37.8-80.7	0-100
<i>Sleep Problems Index</i>	166	29.0 (17.0)	0-73.3	0-100
<i>Perceived Stress Scale</i>	166	22.2 (5.6)	10-43	10-50
<i>Diet self-efficacy</i>	164	18.7 (3.7)	8.3-25	5-25

Table 3. Correlation matrix

	Sleep Problems Index	Perceived Stress Scale	Diet self-efficacy
Perceived Stress Scale	0.39*	-	-
Diet self-efficacy	-0.04	-0.32*	-
Total HEI	-0.09	-0.11	0.33*

* $p < 0.01$

The potential moderating effect of self-efficacy was assessed with another linear regression in two blocks, controlled for BMI and income. The first block was significant ($p = 0.005$) with an adjusted R^2 of 0.079. Only diet self-efficacy significantly predicted total HEI, with a 0.77-point increase in total HEI score for each one-point increase in diet self-efficacy

($\beta=0.31$, $p<0.001$). Next, interaction terms were added for sleep quality \times diet self-efficacy and perceived stress \times diet self-efficacy. Inclusion of these terms increased the adjusted R^2 value to 0.124. The overall model was significant [$F(8,149)=3.78$, $p<0.001$] and revealed a significant interaction between perceived stress and diet self-efficacy ($\beta=0.23$, $p=0.005$), but no significant interaction between sleep quality and diet self-efficacy ($p=0.78$). Table 4 summarizes the model parameters.

Table 4. Summary of model parameters

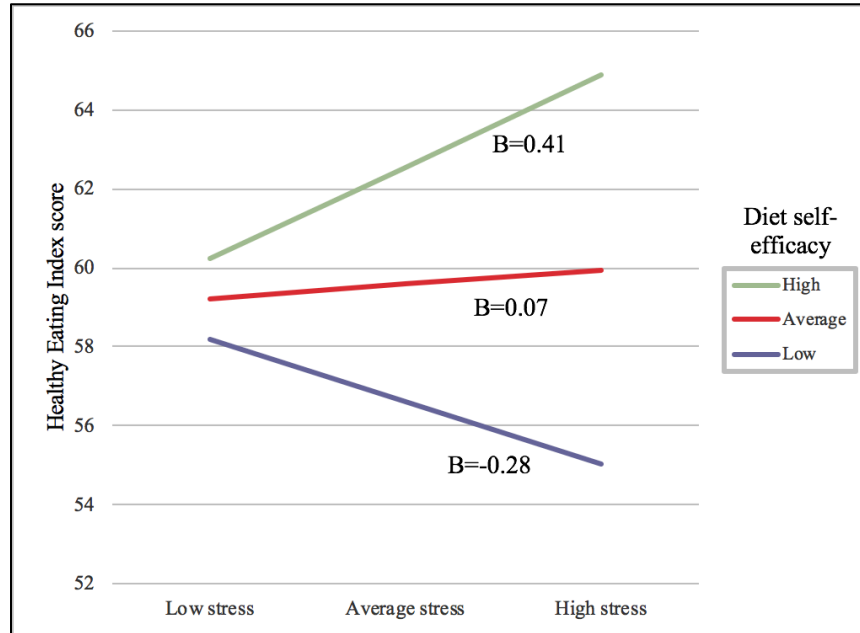
	Block 1^a			Block 2^a		
	B (SE)	β	p	B (SE)	β	p
Sleep quality	-0.03 (0.05)	-0.05	0.57	-0.02 (0.05)	-0.04	0.62
Perceived stress	0.05 (0.14)	0.03	0.75	0.07 (0.14)	0.04	0.64
Diet self-efficacy	0.77 (0.20)	0.32	<0.001	0.79 (0.20)	0.32	<0.001
Sleep quality \times Diet self-efficacy	-	-	-	0.003 (0.01)	0.02	0.78
Perceived stress \times Diet self-efficacy	-	-	-	0.09 (0.03)	0.23	0.005

^aControlled for BMI and yearly household income

Bold values are significant

The significant interaction between perceived stress and diet self-efficacy is illustrated in Figure 1, where high and low refer to 1SD above and below the mean, respectively. When diet self-efficacy was low, perceived stress was associated with lower diet quality ($B=-0.28$). Alternatively, when diet self-efficacy was high, perceived stress was associated with higher diet quality ($B=0.41$).

Figure 1. Interaction of perceived stress and diet self-efficacy



DISCUSSION

The purpose of this study was to examine the relationship between sleep quality, perceived stress, diet self-efficacy, and diet quality in FCCH providers. Diet self-efficacy was the only factor with a statistically significant correlation with diet quality. However, the significant interaction between perceived stress and diet self-efficacy could be important to understanding what contributes to diet quality in this population.

Despite the body of literature describing the relationship between stress and diet, perceived stress was not significantly correlated to diet quality scores in this population of FCCH providers. While perceived stress and diet quality were not significantly correlated, we did find that diet self-efficacy moderated the perceived stress-diet quality relationship. At low levels of diet self-efficacy, perceived stress was associated with poor diet quality; at high levels of diet self-efficacy, the opposite relationship was observed. This result provides support to Bandura's assertion that individuals with high self-efficacy are able to surmount stress to overcome challenges,¹⁷ in this case potentially allowing individuals to maintain a healthy diet despite stress.

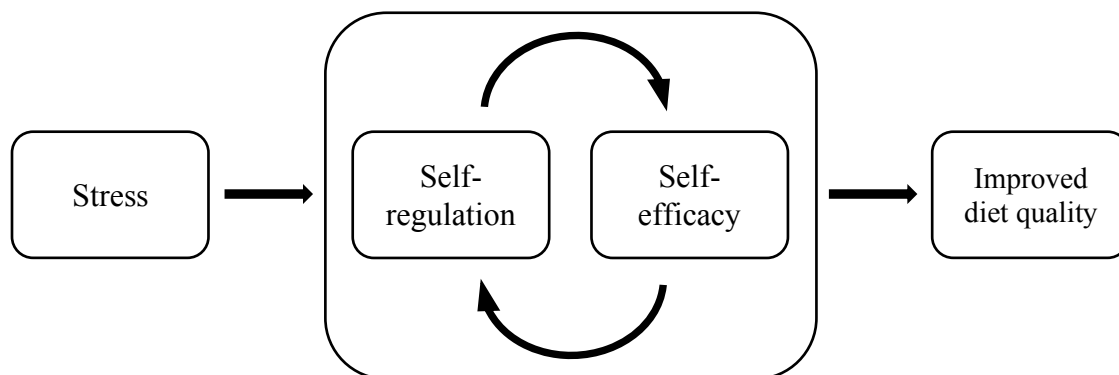
It has been shown that self-efficacy moderates the process of translating intention to consume fruit and vegetables into action.³⁸ It is possible that self-efficacy could similarly moderate an individual's response to stressors that frequently arise during dietary behavior change. Greeno and Wing describe an individual-difference model of stress-induced eating.³⁹ Under this model, an underlying factor, usually psychological or environmental, determines

one's vulnerability to stress-induced eating. Our results hint at self-efficacy as a potential underlying factor within the individual-difference model.

The individual-difference model of stress-induced eating best explains why diet self-efficacy may prevent the decline in diet quality with increasing stress. However, the results from this study also show that with high diet self-efficacy, high perceived stress is associated with better diet quality. While research is needed to determine whether an increase in stress over time could confer improvements in diet quality, a proposed mechanism was suggested (Figure 2).

Bandura suggests that those with high self-efficacy overcome stress by coping and exercising control.¹⁷ For behaviors relating to the diet, coping may often take the form of self-regulatory behaviors (for example, calorie counting or daily weighing). Several studies demonstrate that the effects of self-efficacy on dietary and weight outcomes are mediated through self-regulatory behaviors such as goal setting and self-monitoring.^{18,40} A systematic review of mediators of dietary behavior change finds that self-regulation is a better mediator of long-term changes than self-efficacy alone.⁴¹

Figure 2. Proposed effect of stress on diet quality with high diet self-efficacy



Conversely, it has also been demonstrated that the effects of self-regulatory behaviors such as goal setting on dietary behaviors can be mediated by self-efficacy.⁴² Through SCT, Bandura describes self-efficacy assessments as an ongoing and reciprocal process.¹⁷ When an individual takes a self-regulatory action, the results of that choice are evaluated in future assessments of self-efficacy. If successful, self-efficacy increases and contributes to more self-regulatory behaviors. The cycle continues, and in the face of mounting stress, efficacious individuals are able to not only cope, but ultimately initiate behaviors to improve their diet.

This is not to suggest that stress is a useful means to improve the diet of individuals with high self-efficacy, but instead explains a potential mechanism for how individuals could overcome stress. In fact, the correlation between diet self-efficacy and perceived stress in this study suggests that increasing levels of perceived stress are associated with lower levels of diet self-efficacy. In practice, most individuals, especially women, revert to coping behaviors that are detrimental to health, such as overeating, when triggered by stress.⁴³

Stress is an inevitability in the world of early childhood education. Providers describe their stress to be related to dealings with parents, the health of the children under their care, demands of caring for many children across developmental stages, and public perceptions of their role.¹⁰ Improving their self-efficacy may help to prevent these multiple stressors from impacting their health negatively.

Although hypothesized, this study did not find that sleep quality was related to provider diet quality. There are several potential explanations for this. First, slow wave sleep is the sleep measure most often associated with sleep quality and resulting health outcomes.¹¹ It is possible that the items contained within the Sleep Problems Index do not capture issues that result in altered slow wave sleep. Defining sleep quality is difficult, and differing results in the literature

may be explained by the varied definitions and measurements by which it is assessed.⁴⁴ Future work should focus on standardizing how sleep health is defined using components of satisfaction, daytime alertness, timing, efficiency, and duration.⁴⁵

It is important that ongoing research continue to utilize sleep as a measure of overall health. Improvements in the consistency and sufficiency of sleep have been shown to improve both psychological strain and self-regulating behavior.⁴⁶ Due to the reciprocal relationship between sleep and stress, it would be inappropriate in many cases to separate them when explaining their contributions to health.⁴⁷ Indeed, more sleep problems contributed to high perceived stress among the FCCH providers.

The present study takes an additional step towards describing the determinants of the health of FCCH providers, a group at risk for high stress, poor sleep, and obesity. The implications of intervening in this group should not be underestimated. The amount of time that children spend under the care of ECEs, including FCCHs, implicate them as potential models for beneficial health behaviors. One survey of ECEs in Georgia found that almost 80% do not believe their health has an impact on the quality of their care.⁴⁸ This is not to say that ECEs with poor health behaviors do not provide high quality care in many domains. However, interventions in this population should seek to inform ECEs of their potential impact and encourage them to include child health promotion in their definition of quality care. These messages are likely to be well-received: many providers report confidence in their ability to help children with improving in healthy eating and physical activity.⁴⁹ Their confidence in their own abilities, however, is lacking.^{4,49} Improving provider self-efficacy could benefit both provider and child.

The issues that contribute to the health of ECEs are complex and should be considered in context. This study only takes a small step towards examining how several factors may

contribute individually and together towards their health. Future work should consider “philosophical, psychological, physiological, organizational science and sociological sources” to holistically contribute to provider health.⁵⁰ Indeed, though this study addresses several determinants of provider health, many of these factors are not considered. Although our model accounts for only 12% of the variance in diet quality, highlighting the complexity of this behavior, self-efficacy is a modifiable factor that should be included in interventions for improving both provider and child diet quality.

It is important to remember that these results are cross-sectional and should be interpreted with caution. Future work could determine more explicitly how diet self-efficacy may moderate the effect of stress on diet quality over time. We acknowledge that, while important, it was outside the scope of this study to fully explore the potentially competing reciprocal effect of diet itself on both sleep quality and perceived stress. There is evidence that specific foods and macronutrients contribute to the quality of one’s sleep.⁵¹ Research is less conclusive, but growing, on how one’s diet can affect perceived stress as well.⁵²

This study did not collect an objective measure of sleep quality which may explain the lack of association between sleep quality and diet quality among FCCHs. Perceived stress and diet self-efficacy were assessed via self-report as well, but the scales were well validated and are ideal methods for collecting information on social-cognitive factors. However, diet quality was measured via self-report and creation of a modified HEI score that has not been validated.

This study utilized data from a convenience sample of FCCH providers recruited for a larger intervention trial. Perceived stress levels and diet self-efficacy for this group may have been different than the typical ECE population. However, this sample was fairly representative of the larger ECE workforce in North Carolina on the basis of sex, race, education, and income.⁵³

Finally, though the FCCH population was expected to be at increased risk for poor diet quality, this sample had an average HEI score of 59.6, nearly identical to that of the larger American population.⁵⁴ This score may not be representative of the FCCH population at large, but is much less than ideal, suggesting there is certainly still work to be done to improve their diet quality.

FCCH providers frequently experience work-related stressors that make it difficult to manage their own diet quality and overall health. With their close relationships to families and time spent caring for children, intervening to improve the health of this population may benefit more than the providers alone. Although this study provided some insight into how self-efficacy may moderate the association between FCCH provider stress and diet quality, more work is needed to describe the nature of these relationships and to ultimately develop specific strategies for supporting health among this population.

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